EYELID CHEMICAL BURNS: A MULTIDISCIPLINARY AND CHALLENGING APPROACH

BRÛLURES CHIMIQUES DES PAUPIÈRES: UNE APPROCHE COMPLEXE ET MULTIDISCIPLINAIRE

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SUMMARY. During second- and third-degree eyelid sulfuric acid burns, many surgeons prefer to wait until primary wound separation occurs before grafting. However, this approach may miss the chance to recover the eyelids and can cause ectropion, resulting in delayed eyeball healing with exposure keratitis. We propose that early eyelid release and grafting makes a significant difference in long-term outcomes and improves eyeball healing. Here, we present the case of a woman who presented second- and third-degree burns of the eyelids secondary to physical domestic assault with acid, who had an early surgical management with a full-thickness skin graft. Ten days after surgery, we found that the graft had survived totally, and the donor site of the right arm had already healed. Eyelids were successfully grafted and the functions of both eyelids were well recovered, allowing complete cover of the eyeball. Two months after surgery, functional and cosmetic results were satisfying, with no postoperative lagophthalmos or difficulties with exposure-related problems. Case reports of eyelid chemical burns are very few. No specific and codified management of eyelid chemical burns was found in the literature search. This case report demonstrated that a multidisciplinary approach led by both ophthalmologists and plastic surgeons must be decided early (<6h) in order to achieve synergistic and coordinated management between the eye and the eyelid. There is a significant improvement in ocular healing with early excision and grafting of eyelids after sulfuric acid burn.

Keywords: chemical burns, eyelid injuries, early skin graft

RÉSUMÉ. *En cas de brûlure du 2ème ou du 3ème degré des paupières par acide sulfurique, de nombreux chirurgiens préfèrent attendre la séparation spontanée de l'escarre avant de greffer. Cette stratégie comporte le risque d'une cicatrisation défectueuse source d'ectropion, d'occlusion incomplète et de kératite. Nous conjecturons qu'une excision-greffe précoce améliore le pronostic à long terme de ce type de brûlure. Nous présentons le cas d'une femme victime d'une agression intra-familiale à l'acide sulfurique, souffrant de brûlure des 2ème et 3ème degrés des paupières traitée par excision-greffe de peau totale précoce. À J10, la greffe était totalement intégrée et le site donneur (bras droit) était cicatrisé. La fonction palpébrale était normale et l'occlusion oculaire complète. Ces bons résultats persistaient à 2 mois, sans lagophtalmie ni défaut d'occlusion, avec un aspect esthétique correct. Les rapports de brûlures chimiques des paupières sont peu fréquents et il nous n'avons pas trouvé de protocole dans la littérature. Ce cas clinique illustre la nécessité d'une analyse précoce (dans les 6h) par ophtalmologiste et plasticien afin de définir une stratégie coordonnée vis à vis du globe oculaire et de la paupière. L'excision-greffe précoce améliore la pronostic oculaire après brûlure par acide sulfurique.*

Mots-clés: *brûlure chimique, paupières, greffe précoce*

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Introduction

The face is a frequent site of burns.[1] These injuries may be associated with significant medical and psychological morbidity.[2] Eye and eyelid involvement is common in facial burns, with approximately 15 to 20% of patients presenting orbital injury.[2,3] Burns can be caused by heat, electricity, or chemical exposure. Most periorbital burns are the result of thermal injury;[4] however, chemical burns are reported to comprise 1.4–8.5% of all admission cases due to burns.[5-7] In developing countries, 80% of chemical burns are due to industrial exposure and 20% to physical assault.[8] The majority of patients are of working age and acids are the most common causative agent. Such burns are commonly small in size, and the most common burn areas are the face and limbs.[9-10]

For acids, sulfuric acid, hydrochloric acid and hydrofluoric acid are the most commonly seen in burns. For alkalis, sodium hydroxide and potassium hydroxide are the most common. Both acids and alkalis can cause immediate skin burns on exposure.[11] Sulfuric acid is one of the agents most often involved.[12,13] It is a corrosive, oily, colourless liquid with a specific gravity of 1.85 and a boiling point of 340°C. It generates significant heat when diluted and is highly hygroscopic. These attributes make sulfuric acid an effective drain cleaner, and a substantial number of accidental and intentional incidents are caused by drain cleaners.[14] The majority of chemical burns of the eyelids are partial-thickness (first and superficial second degree) and heal spontaneously within 1 week. However, 10% of cases are full-thickness (deep second and third degree) burns that require release of contractures and grafts.[15,16] Burns to the eyelids can lead to ocular damage; therefore, management of eyelid burns remains one of the greatest challenges for ophthalmologists and plastic surgeons in burn centres.[17] Eyelid burns that are full thickness are excised as soon as the overall status permits. The objectives of eyelid burn management include: restoration of the anatomy of the eyelid to allow protection of the eye, motility of the reconstructed eyelid, and a cosmetically acceptable result.[18,19] In second and third-degree eyelid burns, many surgeons prefer to wait until primary wound separation occurs before grafting.[20] However, this approach may miss the chance to recover the eyelids and can cause ectropion, resulting in delayed eyeball healing and exposure keratitis. Timing of eyelid chemical burn management remains unclear, especially for second-degree burns. We propose that early eyelid release and grafting makes a significant difference in long-term outcomes and improves eyeball healing. Here, we present the case of a woman who presented second- and third-degree burns of the eyelids secondary to physical domestic assault with acid, who had early surgical management with a full-thickness skin graft.

Patient and method

A 43-year-old female suffered a domestic assault with acid in March 2019. She was splashed with sulfuric acid and sustained chemical burns involving her face and upper body. After removing the contaminated clothes and copious lavage for 20 minutes on-site, the patient was immediately sent to the burns unit at Percy Military Hospital (Clamart, France) 2h post-exposure. On admission, the patient was conscious and oriented, spontaneously breathing, and no thoracic pain, palpitations, nausea, vomiting or neurological deficits were seen. She presented burns affecting 8% of the total burn surface area (TBSA), of which 6% were deep dermal to full thickness; second- and third-degree deep burns on the face (right forehead and eyelids) and superficial second-degree burns on her upper body (right arm and trunk). The right arm and trunk did not need any surgical procedure and were managed with daily care dressing. The patient also presented a right ocular injury, classified according to the Dua classification scheme[21] as a grade IV burn; two-thirds of the inferior corneal and conjunctival epithelial defect with limbal ischemia (*Fig. 1*). The best-corrected visual acuity was 20/32 in the right eye. Because of the extensive epithelial breakdown of the ocular surface of the right eye, we decided to manage the eyeball first before treating the eyelids. Eye decontamination was performed with multiple rinses with saline solution. A cryopreserved amniotic membrane onlay graft was placed on the surface of the eye three times to conserve limbal stem

Fig. 1 - Inferior corneal and conjunctival epithelial defect with limbal ischemia

cells, reduce pain and encourage epithelialisation. Ten days from the initial injury, symptoms were completely resolved, ocular surface inflammation was notably reduced, limbal reepithelialisation was complete, and the cornea was clear. Therefore, we decided to perform an early eyelid management (11 days from the initial injury) to release the contracture, which would prevent ectropion and eye injury. After a multidisciplinary discussion, we decided to release the upper and lower burned lids at different times (upper eyelid first) in order to continue to instil the eye drops for corneal healing. Each surgical procedure included a two-staged procedure (debridement and full-thickness skin graft).

Upper eyelid surgery

Local anaesthesia was induced with 1% lidocaine adrenaline. A tangential excision of the necrotic eschar (*Fig. 2*) was made 2 to 3 mm above and parallel to the palpebral margin. The excision passed into the musculus orbicularis oculi, enlarging the eyelid space. The upper lid was released with a 7- to 10-mm incision above the lash line and was extended laterally to the temporal area above the transcanthal line to restore the natural fold (*Fig. 3*). The peri-orbital areas were dermabraded. A full-thickness skin graft (wide and longer than upper eyelid excision) was grafted and fixed with 3-0 suture (*Fig. 4*). The skin grafts were harvested from the inner arm.

Fig. 2 - Deep second- and third-degree eyelid burns

Fig. 3 - Upper eyelid excision; forehead excision was performed at the same time

cessfully grafted and the functions of both eyelids were well recovered, allowing complete cover of the eyeball. Six months after surgery, functional and cosmetic results were satisfying, with no postoperative lagophthalmos or difficulties with exposure-related problems (*Fig. 8*). In addition, the patient exhibited a clear cornea with best-corrected visual acuity of 20/64 and no inflammation or scarring in the right eye.

Fig. 8 - Postoperative result at two months

Discussion

Eyelid involvement is common in facial thermal burns. However, studies on eyelid chemical burn injuries, especially by sulfuric acid, are few.[22,23] Sulfuric acid causes dehydration damage and creates heat in the tissue,[24] producing coagulation necrotic eschars with thrombus formation in the microvasculature of the lesion.[24,25] Excessive pain is usually associated with the burn.[25] Since severity depends on the nature, concentration, volume and duration of contact with the chemical agent, and the mechanism of action of the agent involved, it is difficult to assess the severity of the injury immediately after exposure.[26]

Estimating the depth of chemical burns can be difficult. A severe, full-thickness eyelid burn may appear superficial with only mild discoloration of the skin and eyelid injury may be underestimated. Therefore, in sulfuric acid burns, repair cannot proceed until the causative agent is neutralised or removed.[26] Tissue destruction proceeds as long as the chemical agent is present.[26] Thus, skin decontamination is the most important priority at the beginning. The current recommended treatment for eye exposure to sulfuric acid is water or 0.9% saline decontamination and works by mechanically rinsing the sulfuric acid from the eye and eyelids. This also permits the dilution of the sulfuric acid, attempting to restore the pH back to safe limits.[27-29] However, as water has no chemical action, it cannot control the corrosive and toxic potential of sulfuric acid.[29] Furthermore, as the corneal surface and dermal skin are highly permeable to sulfuric acid, it is imperative that mechanical rinsing with water is performed immediately in order to have effect, otherwise the acid penetrates deeper and it is too late to prevent further damage.

In our patient, we decided to perform extensive eyelid and ocular rinsing with saline solution at admission to the burn unit. In addition, rinsing was continued in the operating theatre. The patient was transferred to the operation theatre to perform a detailed inspection of the ocular and eyelid injuries under general sedation. In orbital chemical burns, a multidisciplinary approach led by both ophthalmologists and plastic surgeons must be used in order to achieve synergistic and coordinated management of the eye and eyelid. In our case, we decided to manage the eye first due to gravity signs limbal ischemia and wide corneal defect. The acute management included gentle eyelid and eyelash hygiene to prevent crusting. Cryopreserved amniotic membrane onlay grafts, topical ophthalmic antibiotic ointments and artificial tears should be applied frequently.[30] The upper eyelid is responsible for moistening the cornea.[31]

Patients with eyelid burns should be examined daily to identify lagophthalmos, which can delay corneal healing.[31] Tarsorrhaphy has been advocated for corneal protection in the past, but it cannot prevent lid retraction in the long term, and is not a substitute for timely skin grafting.[31] Anterior, intermediate and posterior defects of the eyelid should be carefully identified in order to perform the most appropriate management.[32] Anterior lamella

eyelid defects are usually managed with full-thickness skin grafts, intermediate defects with dermal grafts, and posterior defects with oral mucosa.[32] The degree of contraction of a split thickness skin graft may vary considerably, reaching up to one quarter of their original size.[33] Brown et al.[34,35] showed that the capacity of a skin graft to inhibit wound contraction is directly proportional to the amount of structurally intact dermal collagen present in the skin graft. It follows that full thickness grafts have much more dermis present and subsequently contract much less. We believe that grafting full thickness skin in both the upper and lower eyelids reduced the incidence of ectropion, without affecting function.

At the time of surgery, it is important to release the eyelids as fully as possible. There is controversy surrounding how this procedure is managed. Huang recommends incision and release only, suggesting that eschar need not be excised.[36] It is suggested that this approach avoids damage to any viable orbicularis oculi. However, we and others[37,38] consider escharectomy to viable tissue essential to prevent further contracture, while also providing a healthy wound for skin graft take. The timing of deep eyelid burn debridement is also controversial. Clinical priorities may mean burns elsewhere are treated first. In addition, the good blood supply in the eyelid skin may help avoid contracture in the first 3 weeks. Therefore, some authors recommend performing eyelid burn debridement at a later time compared to burns elsewhere. According to other authors, debridement should be delayed until 1 month after the initial injury, in order to allow maturing of the scars.[39,40] The rationale for delaying surgical intervention on the eyelid for as long as possible is that an early operation might have to be repeated during the remaining hospital course, and these repeated surgical manipulations of the upper eyelid might damage the underlying fine muscular structures.[40] Nevertheless, we and others[41,42] believe that early excision and grafting (before 2 weeks) of third-degree burns of the eyelids give better protection to the cornea. In the context of deep burns of more than 20–25% of the total body surface, the vital prognosis can be life threatening and it is necessary to ensure this first. The surgical management of the eyelids must then be integrated into the graft excision strategy in order to best reconcile the vital and functional prognosis by optimising the donor sites in order to obtain the best cosmetic result. The rationale for not waiting is that the early excision and grafting will improve eye healing by preventing early contracture and lagophthalmos.

Conclusion

Case reports of eyelid chemical burns are scarce. No specific and codified management of eyelid chemical burns was found in the literature search. Superficial second-degree eyelid burns, diagnosed at the time of admission, are usually treated with lubricants and antibiotics, and nearly always resolve, whereas deep second- and third-degree burns are problematic. This case report demonstrated significant improvements in ocular healing with early excision and grafting of the eyelids. We propose a decision tree in cases of eyelid chemical burns with anterior lamella defects (*Fig. 9*), using a multidisciplinary approach led by both ophthalmologists and plastic surgeons: synergistic and coordinated management combining extensive eyelid and ocular rinsing with saline solution, a detailed inspection of ocular and eyelid injuries under general sedation, cryopreserved amniotic membrane onlay grafts followed by an early excision, and grafting of eyelids conditioned by the skin graft excision strategy retained for the burned patient.

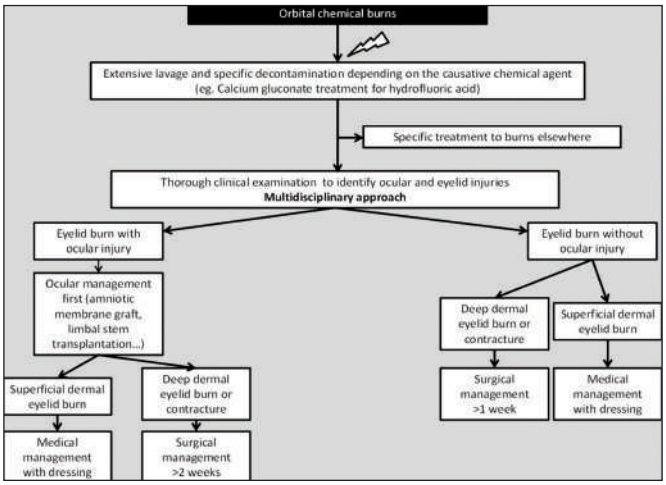

Fig. 9 - Decision tree in cases of eyelid chemical burns with anterior lamella defects

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